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Construction Engineering
Research Laboratory



**US Army Corps
of Engineers.**

Engineer Research and
Development Center

Site Evaluation for Application of Fuel Cell Technology

Naval Education Training Center, Newport, RI

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Foreword

In fiscal years 93 and 94, Congress provided funds for natural gas utilization equipment, part of which was specifically designated for procurement of natural gas fuel cells for power generation at military installations. The purchase, installation, and ongoing monitoring of 30 fuel cells provided by these appropriations has come to be known as the "DOD Fuel Cell Demonstration Program." Additional funding was provided by: the Office of the Deputy Under Secretary of Defense for Industrial Affairs & Installations, ODUSD (IA&I)/HE&E; the Strategic Environmental Research & Development Program (SERDP); the Assistant Chief of Staff for Installation Management (ACSIM); the U.S. Army Center for Public Works (CPW); the Naval Facilities Engineering Service Center (NFESC); and Headquarters (HQ), Air Force Civil Engineer Support Agency (AFCEA).

This report documents work done at Naval Education Training Center, Newport, RI. Special thanks is owed to the Naval Education Training Center points of contact (POCs), John Alfano and Bob Parent, for providing investigators with access to needed information for this work. The work was performed by the Energy Branch (CF-E), of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Michael J. Binder. Part of this work was performed by Science Applications International Corp. (SAIC), under Contract DACA88-94-D-0020, task orders 0002, 0006, 0007, 0010, and 0012. The technical editor was William J. Wolfe, Information Technology Laboratory. Larry M. Windingland is Chief, CEERD-CF-E, and L. Michael Golish is Chief, CEERD-CF. The associated Technical Director was Gary W. Schanche. The Acting Director of CERL is William D. Goran.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Director of ERDC is Dr. James R. Houston and the Commander is COL James S. Weller.

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Contents

Foreword.....	2
List of Figures and Tables	4
1 Introduction.....	5
Background	5
Objective.....	6
Approach	6
Units of Weight and Measure	7
2 Site Description	8
Site Layout.....	8
Electrical System	8
Steam/Hot Water System	8
Space Heating System	9
Space Cooling System	10
Fuel Cell Location.....	10
Fuel Cell Interfaces	11
3 Economic Analysis	14
4 Conclusions and Recommendations	18
Appendix: Fuel Cell Site Evaluation Form.....	19
CERL Distribution	26
Report Documentation Page.....	27

List of Figures and Tables

Figures

1	NETC boiler facility site layout	9
2	Boiler feed water process diagram	10
3	Fuel cell location with proposed thermal and electric runs	11
4	Boiler feed water process diagram	12
5	Fuel cell layout	13

Tables

1	Companion ERDC/CERL site evaluation reports	7
2	Boiler Plant No. 7 make-up water usage	13
3	Newport Naval Education and Training Center electricity consumption	14
4	Newport Electric Corporation rate schedule at NETC	15
5	Economic savings of fuel cell design alternatives	16

1 Introduction

Background

Fuel cells generate electricity through an electrochemical process that combines hydrogen and oxygen to generate direct current (DC) electricity. Fuel cells are an environmentally clean, quiet, and a highly efficient method for generating electricity and heat from natural gas and other fuels. Air emissions from fuel cells are so low that several Air Quality Management Districts in the United States have exempted fuel cells from requiring operating permits. Today's natural gas-fueled fuel cell power plants operate at electrical conversion efficiencies of 40 to 50 percent; these efficiencies are predicted to climb to 50 to 60 percent in the near future. In fact, if the heat from the fuel cell process is used in a cogeneration system, efficiencies can exceed 85 percent. By comparison, current conventional coal-based technologies operate at efficiencies of 33 to 35 percent.

Phosphoric Acid Fuel Cells (PAFCs) are in the initial stages of commercialization. While PAFCs are not now economically competitive with other more conventional energy production technologies, current cost projections predict that PAFC systems will become economically competitive within the next few years as market demand increases.

Fuel cell technology has been found suitable for a growing number of applications. The National Aeronautics and Space Administration (NASA) has used fuel cells for many years as the primary power source for space missions and currently uses fuel cells in the Space Shuttle program. Private corporations have recently been working on various approaches for developing fuel cells for stationary applications in the utility, industrial, and commercial markets. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) have actively participated in the development and application of advanced fuel cell technology since fiscal year 1993 (FY93), and have successfully executed several research and demonstration work units with a total funding of approximately \$55M.

As of November 1997, 30 commercially available fuel cell power plants and their thermal interfaces have been installed at DoD locations, CERL managed 29 of these installations. As a consequence, the Department of Defense (DoD) is the

owner of the largest fleet of fuel cells worldwide. CERL researchers have developed a methodology for selecting and evaluating application sites, have supervised the design and installation of fuel cells, and have actively monitored the operation and maintenance of fuel cells, and compiled "lessons learned" for feedback to manufacturers. This accumulated expertise and experience has enabled CERL to lead in the advancement of fuel cell technology through major efforts such as the DoD Fuel Cell Demonstration Program, the Climate Change Fuel Cell Program, research and development efforts aimed at fuel cell product improvement and cost reduction, and conferences and symposiums dedicated to the advancement of fuel cell technology and commercialization.

This report presents an overview of the information collected at Naval Education Training Center, Newport, RI along with a conceptual fuel cell installation layout and description of potential benefits the technology can provide at that location. Similar summaries of the site evaluation surveys for the remaining 28 sites where CERL has managed and continues to monitor fuel cell installation and operation are available in the companion volumes to this report (Table 1).

Objective

The objective of this work was to evaluate Naval Education Training Center as a potential location for a fuel cell application.

Approach

On 10 and 11 May 1994, Science Applications International Corporation (SAIC) visited the Newport, Rhode Island Naval Education and Training Center (NETC) to investigate it as a potential location for a 200 kW phosphoric acid fuel cell. This report presents an overview of information collected at NETC (the site) along with a conceptual fuel cell installation layout and description of potential benefits. The Appendix to this report contains a copy of the site evaluation form filled out at the site.

Table 1. Companion ERDC/CERL site evaluation reports.

Location	Report No.
Fort Bliss, TX	TR 01-13
Fort Eustis, VA	TR 00-17
Fort Huachuca, AZ	TR 00-14
Fort Richardson, AK	TR 00-Draft
Picatinny Arsenal, NJ	TR 00-24
Pine Bluff Arsenal, AR	TR 01-15
U.S. Army Soldier Systems Center, Natick, MA	TR 00-Draft
U.S. Military Academy, West Point, NY	TR 00-Draft
Watervliet Arsenal, Albany, NY	TR 00-Draft
911 th Airlift Wing, Pittsburgh, PA	TR 00-18
934 th Airlift Wing, Minneapolis, MN	TR 00-19
Barksdale Air Force Base (AFB), LA	TR 01-29
Davis-Monthan AFB, AZ	TR 00-23
Edwards AFB, CA	TR 00-Draft
Kirtland AFB, NM	TR 00-Draft
Laughlin AFB, TX	TR 00-Draft
Little Rock AFB, AR	TR 00-Draft
Nellis AFB, NV	TR 01-31
Westover Air Reserve Base (ARB), MA	TR 00-20
Construction Battalion Center (CBC), Port Hueneme, CA	TR 00-16
Naval Air Station Fallon, NV	TR 00-15
Naval Education Training Center, Newport, RI	TR 00-21
Naval Hospital, Marine Corps Base Camp Pendleton, CA	TR 00-Draft
Naval Hospital, Naval Air Station Jacksonville, FL	TR 01-30
Naval Oceanographic Office, John C. Stennis Space Center, MS	TR 01-3
Subbase New London, Groton, CT	TR 00-Draft
U.S. Naval Academy, Annapolis, MD	TR 00-22
National Defense Center for Environmental Excellence (NDCEE), Johnstown, PA	TR 01-33
Naval Hospital, Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, CA	TR 01-32

Units of Weight and Measure

U.S. standard units of measure are used throughout this report. A table of conversion factors for Standard International (SI) units is provided below.

1 ft	=	0.305 m
1 mile	=	1.61 km
1 acre	=	0.405 ha
1 gal	=	3.78 L
°F	=	°C (X 1.8) + 32

2 Site Description

NETC is located in Newport, RI, which is approximately 30 miles south of the city of Providence. NETC consists of a wide range of buildings including office buildings, central plants, docking facilities, etc. Temperatures range from the teens in the winter to the mid 90s °F in the summer. A central boiler facility (Boiler Plant #7) was identified as the best location for a 200 kW fuel cell at NETC. The building is approximately 100 x 100 ft (10,000 sq ft) and is over three stories tall. The building contains three boilers rated at approximately 75,000 lb/hr. The peak building electric load is around 60 kW.

Site Layout

Figure 1 presents the site layout for the boiler facility. A new high pressure gas line was just installed at the building's southeast corner. The new gas line will be used to run the #3 boiler in Boiler Plant #7, and can be tapped into for supplying the fuel cell input natural gas. The electrical transformer is located on the north side of the building. Up a flight of stairs on the south side of the building is the deaerator system for the boilers. Approximately 30 ft from the building is an old warehouse building that is slated for demolition in the near future. On the west side of the building are fuel storage tanks. Efforts are presently underway to remove a few of the tanks, and ultimately all of them will be removed and replaced by a larger tank away from the boiler facility.

Electrical System

The boiler facility is supplied by a 2400/480 volt transformer (500 kVA), which is located outside on the south side of the building. Electrical switch gear is located on the inside of the building

Steam/Hot Water System

The boiler facility has two Riley Stoker Corp. boilers (75,000 lb/hr) that were built in 1959 and one Nebraska boiler (80,000 lb/hr) built in 1986. The Nebraska boiler is dual fueled and can run off of the new natural gas line just installed.

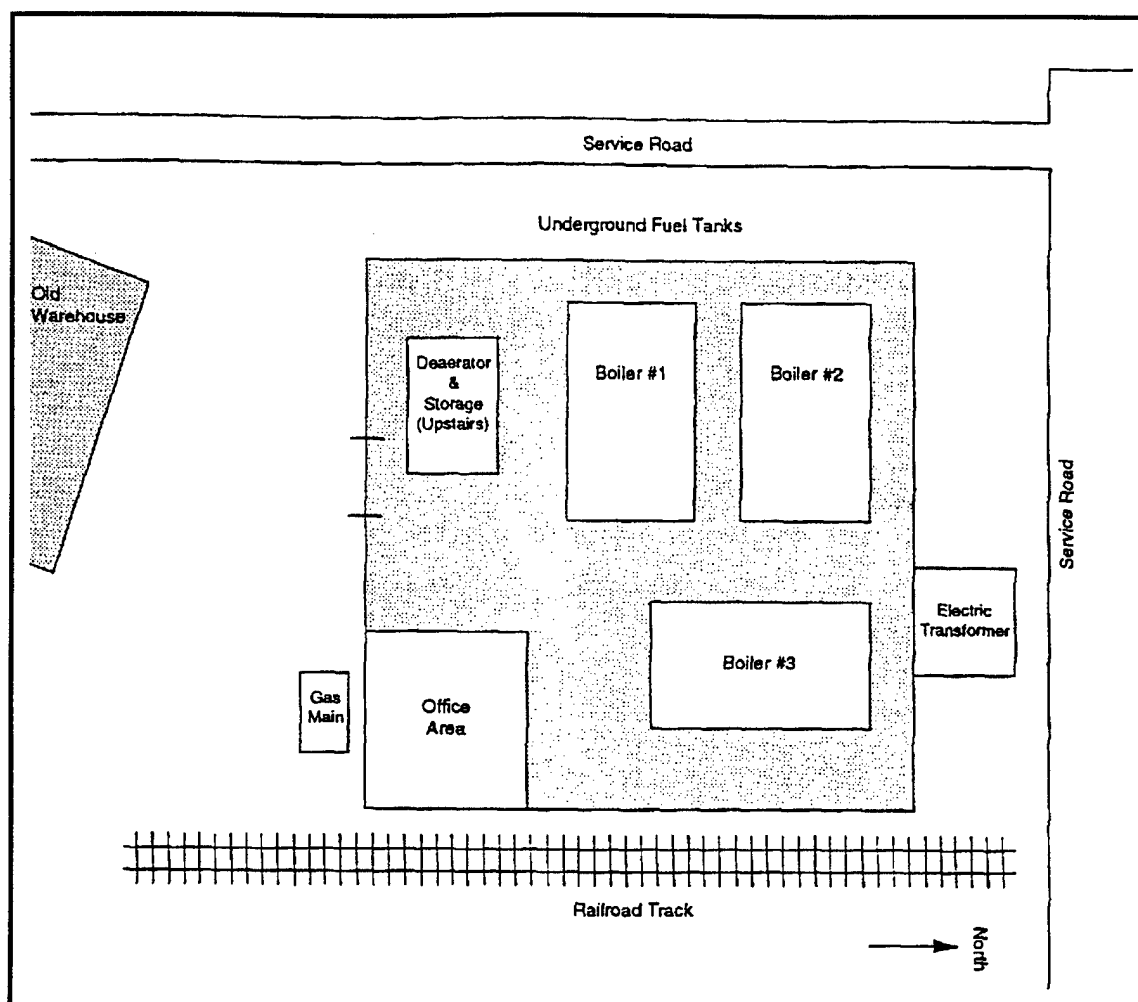


Figure 1. NETC boiler facility site layout.

City water is fed into three 375-gal water softeners and then fed up to a deaerating heater. The deaerator also receives water (and heat) from the condensate return loop (Figure 2). The existing steam loop is over 20 miles in length. Because of leaks in the system, the condensate return is only 17 percent of the steam sent out. Water is fed from the deaerator into a storage tank until it is needed for the boiler.

Space Heating System

Steam is sent out to various locations at NETC. Hydronic systems are located in individual buildings.

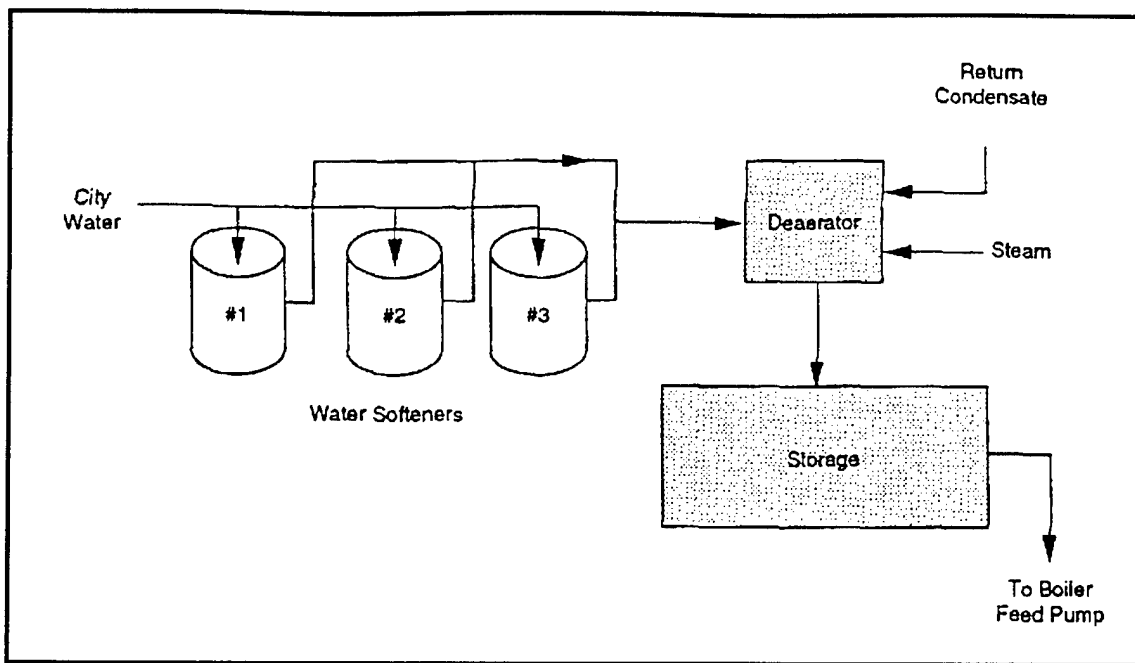


Figure 2. Boiler feed water process diagram.

Space Cooling System

The steam system does not drive any absorption chillers.

Fuel Cell Location

An old warehouse is located on the south side of the building. It is slated for demolition, and NETC personnel are working to expedite this process. This is currently the best location for the fuel cell and it is approximately 30 ft from the boiler facility. Because of the underground fuel tanks on the west side of the building, the fuel cell could not be located right up against the building.

Figure 3 presents the location of the proposed fuel cell site along with proposed thermal and electric runs. The thermal run will be approximately 50 ft across to Boiler Plant #7. Because of underground pipes, it was recommended by Site personnel that the electrical and thermal runs be made across a trellis approximately 15 to 20 ft above the ground. Since the electrical transformer is on the north side of the building, electrical conduit should be run on the outside of the west side of the building and then across the north side. The electrical interface should be made on the 480 volt side of the transformer.

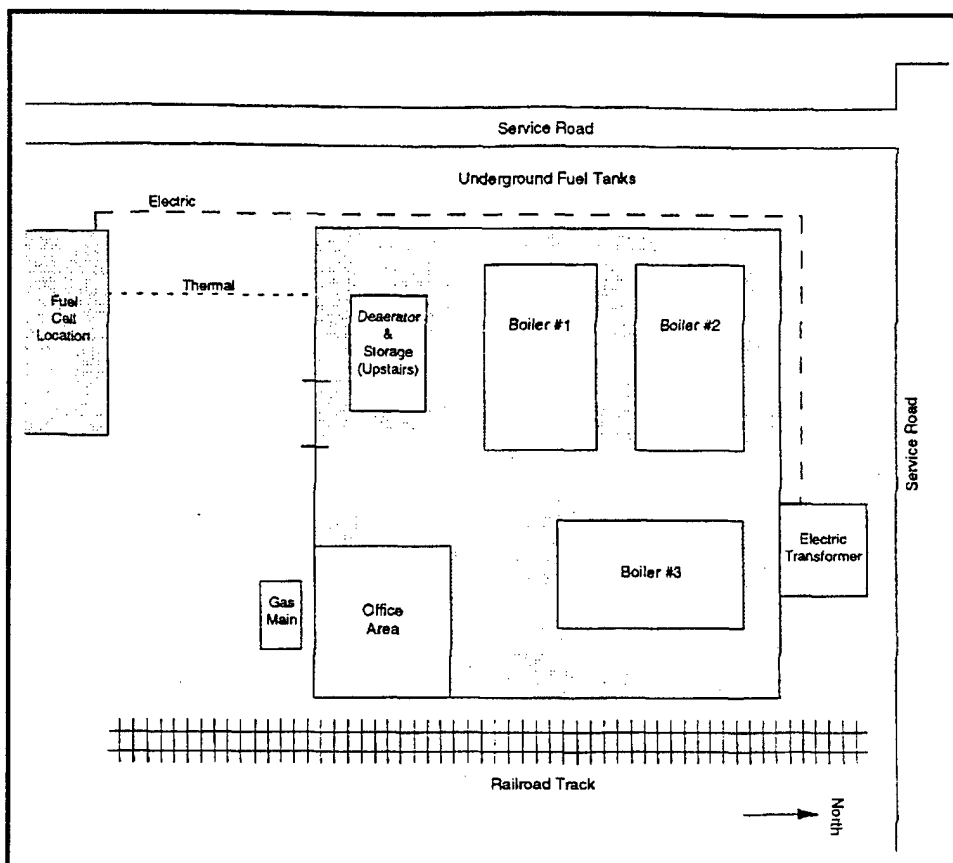


Figure 3. Fuel cell location with proposed thermal and electric runs.

Electric power is supplied to Boiler Plant #7 through a 2400/480 volt, 500 kVA transformer on the north side of the building. It is recommended that the fuel cell be tied into the 480 volt side of the transformer. The estimated electric load of the building is 60 kW. Approximately two-thirds of the fuel cell output will be fed back to the NETC grid when the boiler facility is in operation.

Fuel Cell Interfaces

The proposed fuel cell thermal interface is to pre-heat the boiler make-up water (see Figure 4). Table 2 lists the make-up water usage for the last 3 years. The water usage varied significantly from year to year. This is due to the fact that there are two boiler plants at the Site. These two plants are interconnected. Steam can be fed into the delivery system by either plant or both plants and maintenance activities varied between the facilities. This redundancy allows plants to be taken off-line for maintenance for an extended period of time. When the fuel cell is installed, Site personnel should make an effort to keep Boiler Plant #7 on-line as much as possible to maximize the benefits of the fuel cell thermal output.

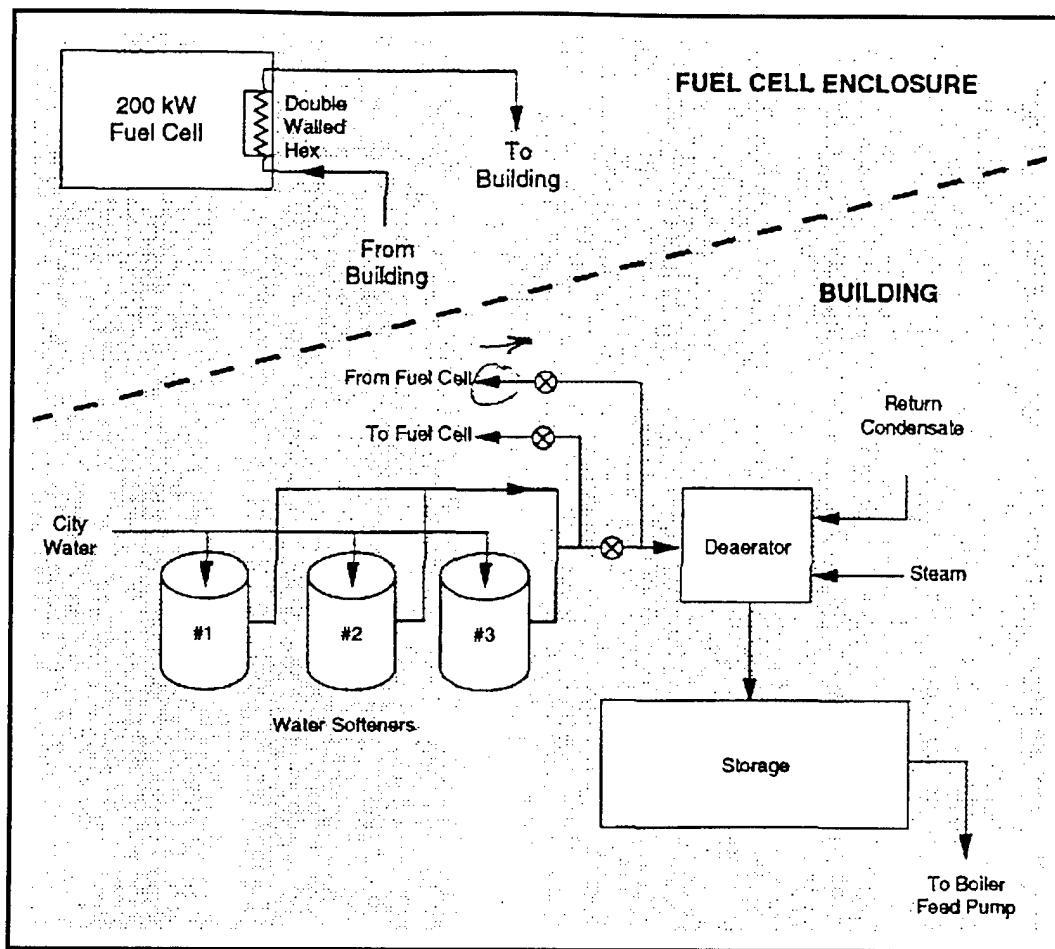


Figure 4. Boiler feed water process diagram.

Hourly make-up water usage data for 25 February 1994 were examined to determine variation in usage and the possible need for thermal storage. The hourly readings showed that the usage profile was fairly flat with a low reading of 6,480 gal/hr and a high reading of 7,290 gal/hr. Since the typical minimum usage does not fall below the threshold requirement of the fuel cell (840 gal/hr), thermal storage would not be required.

Using an average hourly make-up water flow rate for each month, the thermal supplied by the fuel cell was calculated. Based on the make-up water consumption for 1991 (Table 2), 60 percent of the fuel cell thermal output could be utilized by the boiler facility. In 1992 and 1993, 59 and 92 percent of the thermal output could be used by the boiler facility, respectively. At these flow rates and an assumed city water temperature of 60 °F, the fuel cell will supply about 160 °F water. Figure 5 shows a layout of the fuel cell site area.

Table 2. Boiler Plant No. 7 make-up water usage.

Date	FY91		FY92		FY93	
	gal/mo.	F.C. TU*	gal/mo.	F.C. TU	gal/mo.	F.C. TU
October	0	0%	52,364	8%	1,318,700	100%
November	577,980	94%	0	0%	5,088,100	100%
December	607,126	99%	0	0%	5,905,500	100%
January	2,047,630	100%	0	0%	7,393,800	100%
February	2,397,876	100%	5,031,616	100%	8,499,700	100%
March	1,637,610	100%	5,247,000	100%	8,772,000	100%
April	1,290,750	100%	9,549,378	100%	6,944,599	100%
May	580,450	95%	5,042,000	100%	4,159,300	100%
June	64,714	10%	5,042,000	100%	3,271,700	100%
July	43,966	7%	3,266,700	100%	8,367,900	100%
August	10,868	2%	964,861	59%	3,387,900	100%
September	67,184	11%	0	0%	0	0%
Average	777,180	60%	2,849,660	56%	5,259,100	92%

*F.C. TU = fuel cell thermal utilization

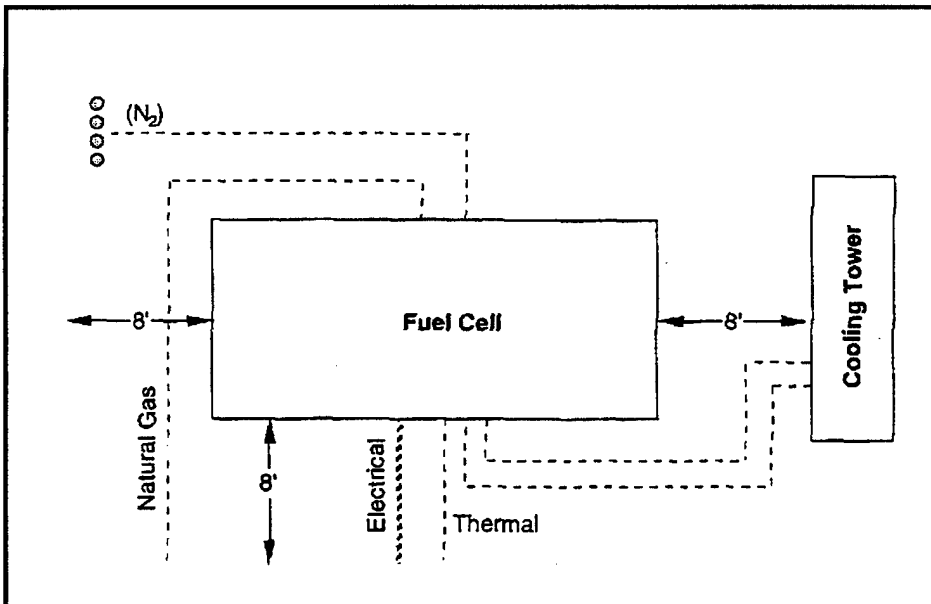


Figure 5. Fuel cell layout.

3 Economic Analysis

NETC is located in Newport Electric Corporation's (a subsidiary of Eastern Utilities) service territory. Table 3 lists electric bills for 1993. The average rate ranged from 9.01 cents/kWh in April to 9.99 cents/kWh in August. The average electric rate paid by the Site in 1993 was 9.49 cents/kWh. The site is billed under a special government contract rate schedule, which is a time-of-use rate. The rate schedule does not have separate rates for "summer" and "winter" months. The on-peak period is between 10:00 a.m. and 4:00 p.m. Monday through Friday (April through September) and 8:00 a.m. to 11:00 a.m. and 4:00 p.m. to 9:00 p.m. Monday through Friday (October through March). The off-peak period is all remaining hours including weekends and holidays. Table 4 lists the demand and energy electric rates under the NETC rate schedule.

The Site receives natural gas from the Providence Gas Company. A new high pressure gas line was just installed at Boiler Plant #7 and no gas bills were provided by the Site. The gas company expects that the firm gas rate for the fuel cell will be \$4.75/MBtu and that the boiler plant gas rate (60 day interruptible) will be \$4.25/MBtu.

Table 3. Newport Naval Education and Training Center electricity consumption.

Date	Peak KW	On-Peak kWh	Off-Peak kWh	Total kWh	Total Bill	\$/kWh
Jan-93	18,165	2,370,212	7,024,500	9,394,712	\$865,503	\$0.0921
Feb-93	19,153	2,524,413	7,653,000	10,177,413	\$930,286	\$0.0914
Mar-93	18,948	2,461,336	6,906,539	9,367,875	\$871,021	\$0.0930
Apr-93	18,631	2,269,948	7,934,929	10,204,877	\$919,757	\$0.0901
May-93	17,333	1,913,945	6,676,244	8,590,189	\$796,417	\$0.0927
Jun-93	17,913	1,991,647	6,964,500	8,956,147	\$828,057	\$0.0925
Jul-93	19,146	2,172,946	8,314,500	10,487,446	\$1,023,432	\$0.0976
Aug-93	19,907	2,313,908	7,698,000	10,011,908	\$1,000,166	\$0.0999
Sep-93	19,473	2,231,439	7,915,500	10,146,939	\$1,003,755	\$0.0989
Oct-93	17,710	2,421,859	7,915,500	10,337,359	\$994,926	\$0.0962
Nov-93	17,432	2,309,034	6,904,500	9,213,534	\$909,394	\$0.0987
Dec-93	17,003	2,523,191	7,776,000	10,299,191	\$983,021	\$0.0954
Total/Avg	18,401	27,503,878	89,683,712	117,187,590	\$11,125,735	\$0.0949

Table 4. Newport Electric Corporation rate schedule at NETC.

Demand Charge			
On-Peak (\$/kW)	\$13.26		
Energy Charge*			
On-Peak (\$/kWh)	\$0.044670		
Off-Peak (\$/kWh)	\$0.038980		
Avg. Adj. (\$/kWh)*	\$0.027480		
Hours/Year			
On-Peak	1,764	20.1%	
Off-Peak	<u>6,996</u>	79.9%	
	8,760		
Savings/Year (90% ELF)			
On-Peak Energy	\$22,909		
Off-Peak Energy	<u>\$83,692</u>		
	\$106,601		
Demand (200 kW)	\$31,824		
Total Savings;	\$138,425		
Average \$/kWh:	\$0.0878		
* Varies monthly, taken from bills (based on fuel adjustment charges)			

Table 5 lists the first year electric savings from a 200 kW fuel cell based on a 90 percent electric capacity factor. It was assumed that the fuel cell outage hours during the on/off-peak periods occurred at the same percentages (Table 4).

In other words, outage hours were not weighted more heavily in either the on-peak or off-peak periods, but were proportional to the number of period hours in a year. Total first year electric savings using a 90 percent electricity capacity factor was \$138,425, which includes full demand charge savings. This works out to an average displaced electric rate of 8.78 cents/kWh (\$25.72/MBtu), which is slightly less than the 1991-1992 DEIS database average of 9.19 cents/kWh (\$26.92/MBtu).

Based on thermal utilization assumptions and an electric capacity factor of 90 percent, the potential energy savings from a 200 kW fuel cell were calculated. Table 5 lists the electric and thermal savings and input natural gas costs for Boiler Plant #7. The net savings for 100 percent thermal utilization was \$106,159 in the first year, \$103,036 based on 90 percent thermal utilization and \$93,656 based on 60 percent thermal utilization. Thermal utilization is dependent on the number of hours that Boiler Plant #7 operates in the year.

Table 5. Economic savings of fuel cell design alternatives.

Case	ECF	TU	Displaced kWh	Displaced Gas (MBtu)	Electrical Savings	Thermal Savings	Nat. Gas Cost	Net Savings
A - Max. Thermal	90%	100%	1,576,800	7,357	\$138,425	\$31,267	\$63,533	\$106,159
A - 90% Thermal Utilization	90%	90%	1,576,800	6,622	\$138,425	\$28,144	\$63,533	\$103,036
A - 60% Thermal Utilization	90%	60%	1,576,800	4,415	\$138,425	\$18,764	\$63,533	\$93,656
B - Max. Thermal	90%	100%	1,576,800	7,357	\$122,513	\$31,267	\$63,533	\$90,247
B - 90% Thermal Utilization	90%	90%	1,576,800	6,622	\$122,513	\$28,144	\$63,533	\$87,124
B - 60% Thermal Utilization	90%	60%	1,576,800	4,415	\$122,513	\$18,764	\$63,533	\$77,744
C - Max. Thermal	90%	100%	1,576,800	7,357	\$106,601	\$31,267	\$63,533	\$74,335
C - 90% Thermal Utilization	90%	90%	1,576,800	6,622	\$106,601	\$28,144	\$63,533	\$71,212
C - 60% Thermal Utilization	90%	60%	1,576,800	4,415	\$106,601	\$18,764	\$63,533	\$61,832
D - Max. Thermal	90%	100%	1,576,800	7,357	\$138,425	\$31,267	\$71,007	\$98,685
D - 90% Thermal Utilization	90%	90%	1,576,800	6,622	\$138,425	\$28,144	\$71,007	\$95,562
D - 60% Thermal Utilization	90%	60%	1,576,800	4,415	\$138,425	\$18,764	\$71,007	\$86,182

Assumptions:

Input Natural Gas Rate: \$4.25 /MBtu

Displaced Thermal Gas Rate: \$4.25 /MBtu

Displaced Electricity Rate: NETC Contract

Fuel Cell Thermal Output: 700,000 Btu/hr

Fuel Cell Electrical Efficiency: 36%

Seasonal Boiler Efficiency: 75%

Case A: full fuel cell demand savings

Case B: 50% of full fuel cell demand savings

Case C: zero fuel cell demand savings

Case D: Case A with "firm" input natural gas @ \$4.75/MBtu w/full fuel cell demand savings

ECF = Fuel cell electric capacity factor

TU = Thermal Utilization

As shown by the data listed in Table 2, a thermal utilization of 60 percent would have been achieved in the years FY91 and FY92, while in FY93 it would have been over 90 percent. The data in Table 5 also show the impact of only achieving 50 percent electric demand savings, zero electric demand savings and running the fuel cell at the \$4.75/MBtu firm gas rate. The difference between the firm and the interruptible gas rate is at most \$7,474 in the first year. (Note that a 90 percent electric capacity factor assumes that the fuel cell will only be down 36 days/year, rather than the 60 day potential for the interruptible gas rate. If the fuel cell is shut down for more than 36 days, then the \$7,474 interruptible rate advantage would be lower.)

The analysis is a general overview of the economics. For the first 5 years, ONSI will be responsible for the fuel cell maintenance. Maintenance costs are not reflected in this analysis, but could represent a significant impact on net energy savings. Since load profile data were not available, energy savings could vary depending on actual electrical and thermal utilization.

4 Conclusions and Recommendations

Boiler Plant #7 at NETC represents a good application of a 200 kW fuel cell. The thermal load of the plant when in operation is larger than what the fuel cell can deliver. No thermal storage is needed at the facility. Maximizing operation of Boiler Plant #7 optimizes utilization of the fuel cell thermal output. The warehouse would need to be demolished to site the fuel cell at the proposed location. Delays in demolition would slow the installation of the fuel cell or require relocation.

Because of underground piping, it is recommended that the thermal and electrical interfaces be trellised over to the building. The thermal interface is just across from the fuel cell site. The electrical interface will need to run along the west and north sides of the building to connect with the existing transformer.

The fuel cell could be also be located next to Boiler Plant #7. The truck road would have to be redirected around the fuel cell installation.

Appendix: Fuel Cell Site Evaluation Form

Site Name: **Newport Naval Education and Training Center**

Location: **Newport, RI**

Contacts: **John Alfano**

1. Electric Utility: **Newport Electric Corp.** Rate Schedule: **Negotiated Contract**
Contact: **Alan Salk**

2. Gas Utility: **Providence Gas Company** Rate Schedule: **To be negotiated**
Contact: **Joe McLaughlin**

3. Available Fuels: **Natural Gas, Fuel Oil** Capacity Rate:

4. Hours of Use and Percent Occupied:	Weekdays	<u>100%</u>	Hrs	<u>24</u>
Plant runs 6-11 months/year	Saturday	<u>100%</u>	Hrs	<u>24</u>
	Sunday	<u>100%</u>	Hrs	<u>24</u>

5. Outdoor Temperature Range: **Teens - 95 °F**

6. Environmental Issues: **Non-attainment area**

7. Backup Power Need/Requirement: **Caterpillar 500 kW reciprocating engine at Boiler Plant #7**

8. Utility Interconnect/Power Quality Issues:

9. On-site Personnel Capabilities: **Gas Company will perform fuel cell maintenance**

10. Access for Fuel Cell Installation: **Truck access O.K.**

11. Daily Load Profile Availability: **No electric data available**

12. Security: **No fence required**

Site Layout

Facility Type: **Central Boiler Plant**

Age: **1950s**

Construction: **Concrete block**

Square Feet: **10,000 sq ft**

See Figure 1

Show:

- electrical/thermal/gas/water interfaces and length of runs**
- drainage**
- building/fuel cell site dimensions**
- ground obstructions**

Electrical System

Service Rating: **2400/480 volt transformer (500 kVA)**

Electrically Sensitive Equipment: **None**

Largest Motors (hp, usage):

Grid Independent Operation?: **No**

Steam/Hot Water System

Description: **Riley Stoker Corp (2); Nebraska Boiler Co. (1)**

System Specifications: **2 - 75,000 lb/hr; 1 - 80,000 lb/hr**

Fuel Type: **Fuel oil, natural gas installed for Nebraska boiler**

Max Fuel Rate:

Storage Capacity/Type:

Interface Pipe Size/Description:

End Use Description/Profile: **Steam from the boiler is used to send out steam for heating, cooking and misc. uses.**

See Figure 1

Space Cooling System

Description: **None**

Air Conditioning Configuration:

Type:

Rating:

Make/Model:

Seasonality Profile:

Space Heating System

Description: **No space heating system noted in facility; hydronic systems on base**

Fuel:

Rating:

Water supply Temp:

Water Return Temp:

Make/Model:

Thermal Storage (space?):

Seasonality Profile: **None available**

ELECTRICITY

NATURAL GAS

OTHER Period	6	7	8	9	10	11	12	13	14
	Consumption				Cost				

1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

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REPORT DOCUMENTATION PAGE

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14. ABSTRACT <p>Fuel cells are an environmentally clean, quiet, and a highly efficient method for generating electricity and heat from natural gas and other fuels. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) have actively participated in the development and application of advanced fuel cell technology since fiscal year 1993 (FY93). CERL selected and evaluated application sites, supervised the design and installation of fuel cells, actively monitored the operation and maintenance of fuel cells, and compiled "lessons learned" for feedback to manufacturers for 29 of 30 commercially available fuel cell power plants and their thermal interfaces installed at Department of Defense (DoD) locations.</p> <p>This report presents an overview of the information collected at the Naval Education Training Center, Newport, RI, along with a conceptual fuel cell installation layout and description of potential benefits the technology can provide at that location. Similar summaries of the site evaluation surveys for the remaining 28 sites where CERL has managed and continues to monitor fuel cell installation and operation are available in the companion volumes to this report.</p>					
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